



Pagami Creek Fire

Summary of Decisions and Information Used in Making Decisions



Superior National Forest
U.S. Forest Service
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Pagami Creek Decision Support Narrative

REPORT OBJECTIVES

The objectives for this report were developed from Forest Supervisor direction.

The objectives were to:

- describe decisions made in managing the Pagami Creek Fire from start to containment,
- describe information available to decision-makers,
- describe rationale for decisions

EXECUTIVE SUMMARY

The Pagami Creek Fire was started by lightning in mid August, 2011 in the Boundary Waters Canoe Area Wilderness (BWCAW) on the Superior National Forest in northeast Minnesota. The fire was discovered on August 18 and initially managed as a natural process with protection objectives established for values within the Fernberg Corridor (non-wilderness mix of public and private lands approximately 2 miles to the north).

On August 26 strong winds and very low relative humidity caused the fire to run about 1 ½ miles to the southeast burning about 135 acres. The fire area was not continuous, but rather numerous spot fires scattered across the landscape. The fire remained well within the BWCAW but its long NW-SE orientation posed a risk of a wide head fire running toward the Fernberg Corridor in the event of southerly winds. The Forest assigned a local Type 3 Incident Commander with handcrews to contain the portion of the fire north of Pagami Creek (about 20 acres). The Type 3 organization was an interim measure to manage the fire while waiting for a larger, more experienced team to arrive. A Minnesota Interagency Type II Incident Management Team (IMT2) was ordered and assumed command of the fire on August 28. After considering several options (including difficult and hazardous handline construction around every spot fire) the team proposed a large aerial firing operation. The intent of the operation was to bring the edge of the fire to bodies of water (Pagami Creek and Lake One) and reduce risk of the fire running north and spotting across the water to the Fernberg Corridor.

The firing operation was conducted on September 4, 5, and 6 when weather conditions were adequate to achieve objectives. About 2,000 acres were ignited, burning an area along the south side of Pagami Creek east to Lake One. The west shore of Lake One was fired south to the Lake One-Lake Two portage. Additional firing occurred to the west of Lake One to burn out balsam fir thickets and jack pine ridges (the areas most likely to cause long range spotting). On-the-ground firing occurred the next two days to fill in gaps missed by the aircraft.

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On September 9th the IMT2 and Superior NF managers reviewed the status of the fire and the results of the firing operation and agreed that threats to the Fernberg Corridor had been sufficiently reduced. The southern portion of the original 135 acre fire had continued spreading south but remained many miles from the BWCAW border. Weather forecasts received that day indicated moderate fire weather for the next couple of days and potential rain in 3-4 days.

Plans to replace the IMT2 with an IMT3 (smaller, local organization) were changed when a new forecast indicated that a frontal system passage with very strong winds would occur before any precipitation.

On Saturday September 10 the fire doubled in size moving south. Reports from aerial observers and the Operations Section Chief indicated that the southern movement started from the southern spot fires of the original 135 acre fire. Portions of the Lake One-Two-Three-Four chain and the Pow Wow Trail were closed. Public Safety Crews moved recreationists out of those areas. The next day the fire grew to about 11,500 acres from a seven-mile run to the SE. Due to the increase in fire activity and threats to public safety an IMT1 (national level team with highest levels skill and experience) was ordered. The need for full containment on all portions of the fire perimeter was recognized. Numerous firefighting resources were ordered and assigned to stop the spread and ultimately contain the fire.

The public closure area was expanded and additional Public Safety crews were assigned to move campers out of the potential path of the fire. Weather forecast for the next day (Monday, September 12th) indicated a frontal passage with strong winds, high relative humidity, and a 70% chance of rain. Shortly after 0900 on the 12th the inversion broke and the fire began moving northeast, pushed by strong southerly winds. The seven mile wide NE flank of the fire had become a broad, rapidly moving head fire. By 1300 the fire had passed the south and east shores of Lake Insula, causing six FS Public Safety personnel to deploy shelters. After an intense hour or so the personnel were able to leave their shelters having incurred no physical injuries.

The frontal passage caused two distinct wind shifts. Shortly after 1300, winds shifted from SW to westerly causing a rapid run to the east. At about 1500 winds shifted to northwesterly, steering the fire to the southeast. Winds were recorded at several weather stations in excess of 15 mph for more than 6 hours. Numerous full time and part-time residents in an area north of Isabella, Minnesota were evacuated by Lake County Sheriff's Department during the late afternoon and early evening of September 12th.

Late that night the winds subsided and humidity rose causing the fire to slow and later stop its spread. The IMT1 arrived, transitioned with the IMT2 and assumed command of the fire on September 16th. Aggressive suppression actions continued with a full containment objective.

BACKGROUND

US Forest Service wildfire response is based on sound risk management. Each wildfire is evaluated to determine potential harm to human safety (firefighters and the public) and likelihood of damage to private property and natural and cultural resources. Natural ignitions may also be evaluated for potential benefits (as defined in the local Forest Land and Resource Management Plan) associated with allowing all or part of the fire to burn. The Wildland Fire Decision Support System (WFDSS) is used by land managers to assist in comprehensively assessing risk and opportunity when developing a plan on how to manage each individual wildfire.

WFDSS assessments incorporate local information on:

- Values-at-risk
- Wildland fuel
- Topography
- Weather – current and forecasted
- Fire Danger Indices
- Climatology
- Seasonal and Long Term conditions
- Land Management Plan guidance

Upon request, analysts assigned to the National Fire Decision Support Center (NFDSC) will model fire behavior using several methods to display fire spread likelihood over the short and long term. These modeling efforts provide reasonable estimates of where the fire might spread and the level of intensity it could exhibit. Some models also assign probability estimates for spread distance which provides managers with an indication of potential damage at distances from the fire origin or current perimeter.

WFDSS assessments are considered dynamic and should be reviewed and potentially updated as frequently as conditions or information change.

AUGUST 18-20, 2011

The Pagami Creek fire was discovered on August 18, 2011 at 1615 hours by a Superior National Forest detection aircraft. Size up of the Pagami Creek fire occurred on August 19, 2011. The fire was estimated at 1/10th acre. The fire was located in a boggy area several miles within the Boundary Waters Canoe Area Wilderness (BWCAW) on the Kawishiwi Ranger District. The initial assessment indicated that it posed no immediate threat to private property. The closest weather station, Fernberg Remote Automated Weather Station (RAWS) recorded 0.02" rain that day.

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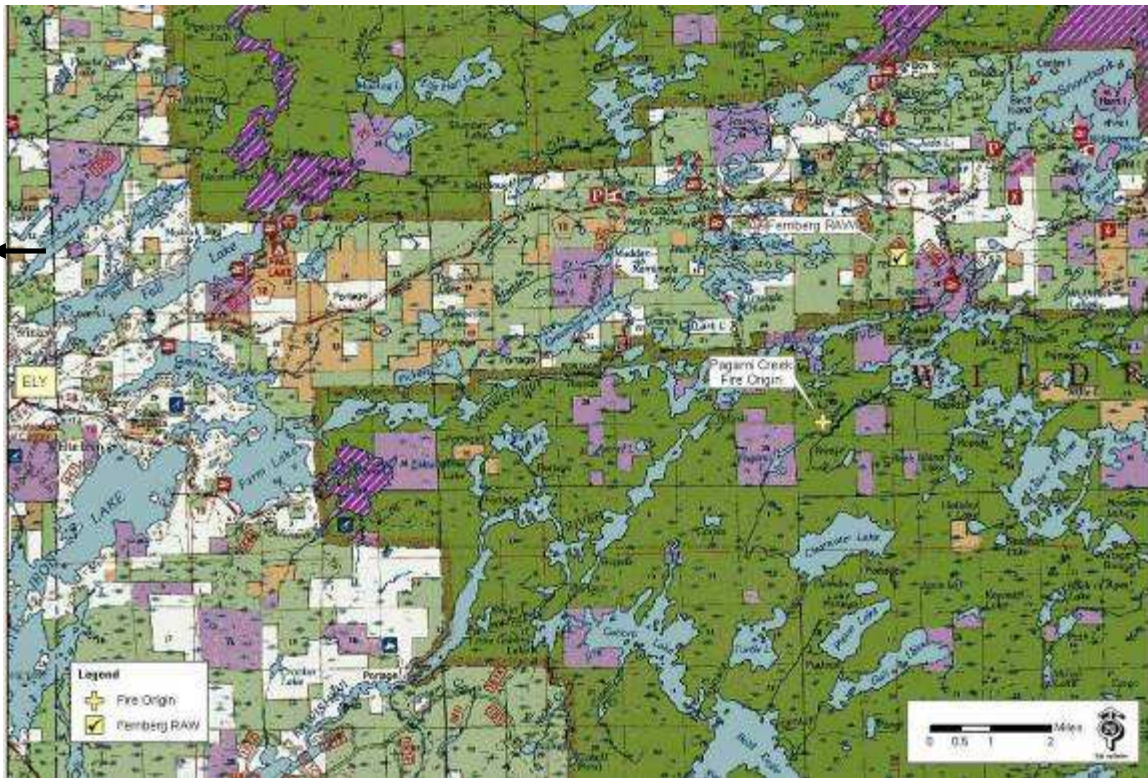


Figure 1. Yellow cross indicates Pagami Creek Fire location on August 20. BWCAW is dark green. Fernberg Corridor is pale green (Superior NF non-wilderness), tan (St Louis County), purple (Minnesota DNR) and white (private) blocks indicating ownership.

An initial decision was made by the Kawishiwi District Ranger on August 18 to monitor the fire and take no on-the-ground action. This was based on current fire behavior for the remainder of the burning period (until sunset on August 18) and expected fire behavior for the next burning period (August 19). In both cases the fire was expected to remain within the bog and continue to exhibit smoldering fire behavior with very little spread. Note: The forecast issued on August 18 called for a chance of showers and thunderstorms through the evening hours, probability of precipitation 50% with accumulation of 0.10-0.20 inches expected with very high humidity recovery. See Appendix A - Weather and Fire Danger Records.

Additional assessments were conducted to determine a long term course of action. These assessments were undertaken on August 19 and 20, 2011 and are described in the following several pages. Note: The Kawishiwi District Ranger was off on Saturday, August 20, 2011. The LaCroix District Ranger had agreed to serve as decision-maker for fire responses during this time. The two rangers were in contact by cell phone and discussed the Pagami Creek Fire.

Between August 18 and August 20, decision-makers and fire management personnel reviewed the following information to determine the response to the Pagami Creek Fire:

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- Values-at-risk: the Fernberg Corridor is 3-4 miles wide by 16 miles long located north of the fire. It is a rectangular parcel of non-wilderness mixed ownership land extending into the BWCAW. The southern border of the Fernberg Corridor is about 2 miles north of the Pagami Creek Fire origin. Values within the Fernberg Corridor include numerous summer and full-time residences, businesses (mostly lodges and outfitter guides), Minnesota Department of Natural Resources (DNR) timber lands, and a communications site with tower and USFS monitoring devices. No other values were identified as being close enough to be threatened by the fire at this initial stage.
- Wildland fuel and topography: the fire was burning in grass-sedge vegetation in deep organic soils. Sphagnum moss was several feet deep in the immediate fire area. Standing and down black spruce was scattered across the bog area. A mature stand of jack pine with balsam fir understory was adjacent to the fire on a low ridge. Immediately adjacent to the fire was a low ridge oriented in a SW-NE direction.
- Weather forecast: the short term forecast indicated a chance of small amounts of precipitation on the night of August 20 and again on the 21st. Winds were predicted to be west (3-6 mph) on the night of August 20 , then NW (5-10 mph) on the 21st and SW (3-6 mph) on the 22nd. Low relative humidity for those three days was expected to be no lower than 38% with humidity recovery as high as 100% at night. These weather conditions are associated with low levels of fire intensity and very slow rates of spread.
- Fire danger indices were about average for August with indications that they would start a decline. Canadian Fire Danger Indices work well for characterizing fire behavior in northern Minnesota. Indices calculated from the Ely and Fernberg RAWS for August 20 predict moderate to high fire behavior and are well within values occurring during prescribed burning in the BWCAW (see figures 9 and 10, page 15).
- Climatology suggested that there was a good chance for weather conditions to become cooler and wetter over the next few weeks with occasional cold front passages. Seasonal graphs for the Canadian Fire Danger Indices show peak fire behavior for the year typically occurring in late August and then slowly declining through September.
- Seasonal conditions exhibited average or lower levels of live and dead fuel dryness. However, drought indicators were inconsistent. One indicator displayed normal conditions while another displayed “abnormally dry” (the least severe of five drought categories). The forecast for the months of September through November indicated “normal” precipitation/drought conditions.
- A review of the Superior NF Land Management Plan and Fire Management Plan revealed guidance that supports the management of lightning-caused fires in the BWCAW as a natural process within sound risk management practices.

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Note: see Appendix A for a detailed listing of information used in developing the August 20, 2011 decision for management of this fire.

Observations

Fire behavior observations are one of the most important considerations when evaluating the immediate response to a wildfire. Factors considered in initial evaluations include flame length, spread rate, surface fire/crown fire, spotting, adjacent fuel and fire behavior expected during the remainder of the burn period considering likely weather conditions. On the Pagami Creek Fire, behavior of other recent fires in the area was also considered.

A USFS DeHavilland Beaver aircraft pilot provided the initial description of the Pagami Creek Fire on August 18, 2011. He reported that the fire was “1/10 acre, lightning strike, north of creek, swamp grass and brush, edge of timber, timber is pine and spruce, open flame, winds SW to west and light.”

The next day, August 19 at 13:40 the Beaver pilot reported that the Pagami Creek Fire was “less than ¼ acre, no open flame, smoldering and smoking on ground; nothing active.”

On August 20 the Beaver flew over the fire at 15:57 and reported “1/4 acre, few smokes; smoldering on the ground; most of fire in open bog area creeping toward edge of trees; fuels jack pine/spruce; winds 5-7 mph; spread potential minimal.”

The Beaver pilot took several photos and emailed them to the West Zone Fire Management Officer and Kawishiwi and LaCroix District Rangers. The photo below was taken mid-afternoon on August 19.



Figure 2. Looking NW at the Pagami Creek Fire on August 19th, 2011

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After reviewing the information listed above, fire modeling was conducted to estimate how the fire would likely burn in the short term and for extended periods. Some of the fire behavior modeling was conducted by the National Fire Decision Support Center (NFDSC) utilizing programs developed at the Rocky Mountain Research Station Fire Lab in Missoula, Montana. Thousands of fire spread simulations were run using local weather forecasting and local fuel information to develop fire spread probabilities. The simulations assumed that no suppression action would occur and modeled the fire as “free burning”.

The assessments indicated very low likelihood that the fire would reach the Kawishiwi River (adjacent to the south border of the Fernberg Corridor).

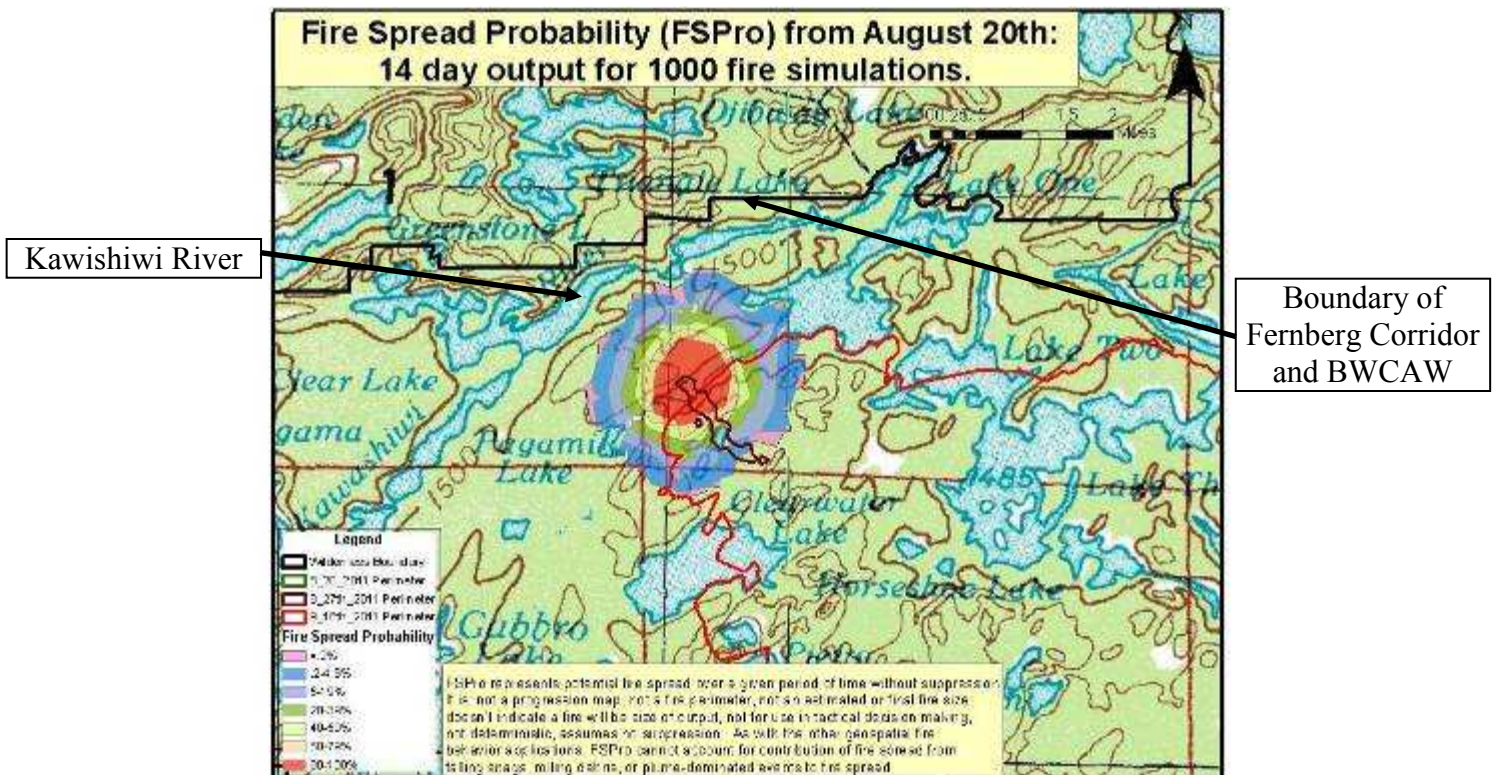


Figure 3. FSPro simulation depicting probabilities for fire movement 360 degrees around the perimeter. Note: the fire has less than 0.2% likelihood of reaching the Kawishiwi River in 14 days even with no suppression action.

Course of Action

Due to the remote location of the fire, forecast for rain, and low fire danger indices it was decided to monitor the fire and take no action on the ground unless weather forecast or fire behavior changed. Although the likelihood of fire damage was very low, contingencies were developed to ensure an effective response should the fire unexpectedly threaten the values in the Fernberg Corridor.

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AUGUST 20-26, 2011

The Kawishiwi District Ranger was absent on leave from August 24 to August 27. The LaCroix District Ranger served as agency administrator for fire-related decisions during this time.

After a decision is made to place a fire in monitoring status, managers closely monitor fire behavior, weather conditions, and forecasted weather and fire danger. The Pagami Creek Fire was monitored from the air (US Forest Service DeHavilland Beaver aircraft) on August 21, 22, and 25. Beaver pilots provided the following descriptions of fire behavior:

August 21 at 15:58 “No smoke, no activity and no size change”

August 22 at 17:43 “over fire, no smoke”

August 25 at 16:03 “open flame, active fire on ground, no tree torching; winds light from NW; fire creeping into the jack pine. No major threat, approximately ½ acre”

The observation of fire behavior provided by the Beaver pilot on the afternoon of August 25 triggered a decision by the West Zone Duty Officer to send two firefighters into the fire to conduct an on-site size-up.

Weather observations for August 21-25, 2011 recorded at 1300 daily at Ely and Fernberg RAWS are displayed in the following table.

Date and Location	Temp	RH	Wind speed	Precip (inches)
August 21 - Ely	68	44	7	0.02
August 21 - Fernberg	70	41	7	0.12
August 22 - Ely	77	48	11	0
August 22 - Fernberg	80	38	6	0
August 23 - Ely	74	71	9	0
August 23 - Fernberg	78	60	4	0
August 24 - Ely	67	61	16	0
August 24 - Fernberg	65	67	14	0
August 25 - Ely	77	53	7	0
August 25 - Fernberg	79	45	5	0.02

Table 1. Ely and Fernberg RAWS observations for August 21-25, 2011.

On Wednesday, August 24 at 1400 hours Ely RAWS recorded NW winds of 21 mph with gusts to 35 mph and at 1200 hours the Fernberg RAWS recorded WNW winds of 19 mph with gusts to 38 mph.

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Weather forecasts for the fire area provided mixed information on drying versus wetting trends. However, none of the forecasts indicated large increases or decreases in fire danger.

The general fire weather forecast issued at 14:59 on August 25, 2011 indicated a cold front would move through northern Minnesota on Friday the 26th. Prefrontal showers and thunderstorms along with increasing winds from the south and southwest were predicted to begin after midnight on the 25th and continue on into the early morning of August 26th. The forecast also called for winds to shift from SW to west and then NW strengthening to 11-16 mph by mid afternoon. The low relative humidity for the 26th was predicted to be 45-50%.

Managers believed that weather and fire behavior on the 26th would be no worse than that experienced on the 24th when the wind was very strong all afternoon. Although humidity was predicted to be lower than the 24th, it would still be above levels associated with large fire growth. In addition, the strong afternoon winds forecasted for the 26th would be coming from the NW, pushing any increase in fire activity away from the Fernberg Corridor.

An incident commander (IC) and a crewmember departed for the Pagami Creek Fire to conduct an on-the-ground size-up at 0852 on August 26, 2011. They arrived at the fire at 11:34. At 12:27 on August 26, the IC reported:

“Burning in upland conifer, size is 1.25 acres. Moderate spread potential. Will continue to monitor at this point. “



Figure 4. Photo taken by IC at about 1200 on August 26, 2011. The brush depicted is in the understory of the jack pine stand on the low ridge adjacent to the lowland where the fire originated.

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The IC used a belt weather kit to take weather observations shortly after arrival. Observations on site were: temperature 77⁰, RH 75%, and eye-level winds SW at 2-5mph with gusts to 8 mph. The IC noted that the sky was heavily overcast. At about this time the Fernberg RAWS recorded temperature of 79⁰, relative humidity of 55% and wind speed of 8 mph. Ely RAWS recorded 77⁰, 71% relative humidity and 9 mph wind speed.

The next radio message delivered by the IC was transmitted at 14:17. He stated, "Forty percent of the perimeter is active with 1-2 ft flame lengths. Some torching is occurring as the afternoon progresses. Acreage is now closer to 2."

Relative humidity began dropping rapidly at 1400. Fernberg RAWS recorded RH of 31% at 1400 and by 1600 it had fallen to 18% and remained at less than 30% until after 1800. The low RH increased probability of ignition significantly which increased spot fire development and overall spread of the fire. Over the next hour it became clear to the IC that the Pagami Creek Fire was growing larger than he could manage with just one crewmember. At 15:11 the IC radioed to MIFC dispatch that he was leaving the fire to return to Ely.



Figure 5. Photo taken at about 1600 on August 26, 2011 from Fernberg Tower site (2 miles north of Pagami Creek Fire).

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Within 20 minutes of starting to paddle out they noticed the smoke column had grown in size and was much darker. Tree torching began and embers were transported downwind. A short while later one of the DeHavilland Beavers fly over the fire and reported that the fire had spotted across Pagami Creek and was actively burning in numerous spots. At 1645 the fire was reported as “30-50 acres, lots of group torching, some possible short crown runs in heavy timber”. The fire ran southeast, spotted across Weasel Lake and slowed in a mosaic of deciduous trees and lowland conifers. By 1730 fire spread had stopped. The area to the south of Weasel Lake was an unconsolidated mass of small spot fires.



Figure 6. Weasel Lake at about 1730 on August 26, 2011.



Figure 7. View from north of Pagami Creek, looking south at about 1800.

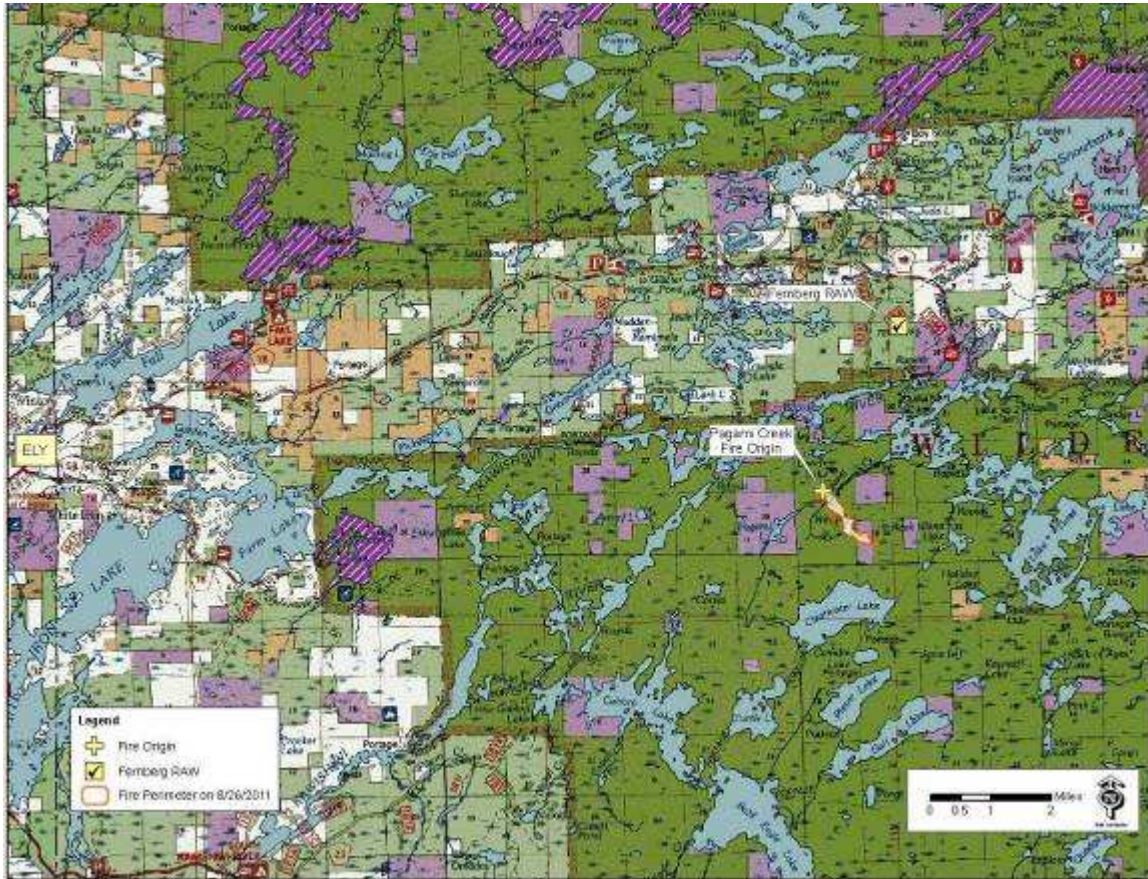


Figure 8. Pagami Creek Fire Perimeter (in red) on August 26, 2011 at 1800.

AUGUST 26, 2011 – NEW DECISION FOR MANAGEMENT

The LaCroix District Ranger arrived at Ely at about 1600 and began working on a new strategy for managing the Pagami Creek Fire. The Forest Supervisor and Deputy Forest Supervisor were informed of the status of the fire. The following pages describe information considered and decisions made.

Values-at-risk

Firefighter and public safety remained the highest priority followed closely by keeping the fire south of the Fernberg Corridor and all of the values previously described.

Fuel conditions

The fuel types involved in this first major run of the Pagami Creek Fire consisted of jack pine ridges, red and white pine stands, and mixed hardwoods with a significant balsam fir component in the understory. Other fuel in the fire area included bog/lowland types with sphagnum moss, grass, brush, and black

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spruce. Most of the trees were no more than about 100 years old as this area was cut by the St. Croix Timber Company between 1892 and 1912.

The Fernberg RAWS estimates of fuel dryness for August 26 were:

- 10 hour time lag (1/4 to 1" diameter) – 10%
- 100 hour time lag (1 to 3" diameter) – 17%
- 1000 hour time lag (3 to 9" diameter) – 20%

These fuel moisture values are within prescription parameters for prescribed burning in the BWCAW.

Current and forecasted weather

The general fire weather forecast issued on August 26 called for scattered thunderstorms and showers until 1200. The forecast also advised that there was a 20% chance of precipitation which would result in accumulation of a trace to .05 inches. The high temperature was predicted to reach 82 and minimum humidity to 33-38% with excellent recovery expected at night. Winds were forecasted to be SW 4-9 increasing to NW 10-15.

The outlook for Saturday August 27 forecasted mostly sunny skies with high temperatures reaching 70-75 and minimum humidity bottoming out at 40-45%; winds were to remain light and variable.

Outlook for Sunday August 28 through September 1 called for a slight chance of showers and thunderstorms followed by a gradual warming trend.

The light winds and moderate levels of relative humidity in the forecast indicated little fire spread would occur over the next few days.

Fire Danger/climatology

Both the Duff Moisture Code DMC and Drought Code DC were slightly above average for this time of year (conditions were more moist than average). However, these dryness indicators began to gradually climb with each rainless day. Herbaceous and woody plant fuel moistures were also slightly above average for the season with no drought stress or frost damage (dropped leaves/needles, browning grasses) evident. Buildup Index (combination of DMC and DC) also increased from 29 on August 18 to 61 (considered "High" fire danger) on August 26.

Fire behavior on the 26th was consistent with a rating of "High", but only for about three hours when strong winds and low RH enabled rapid fire spread.

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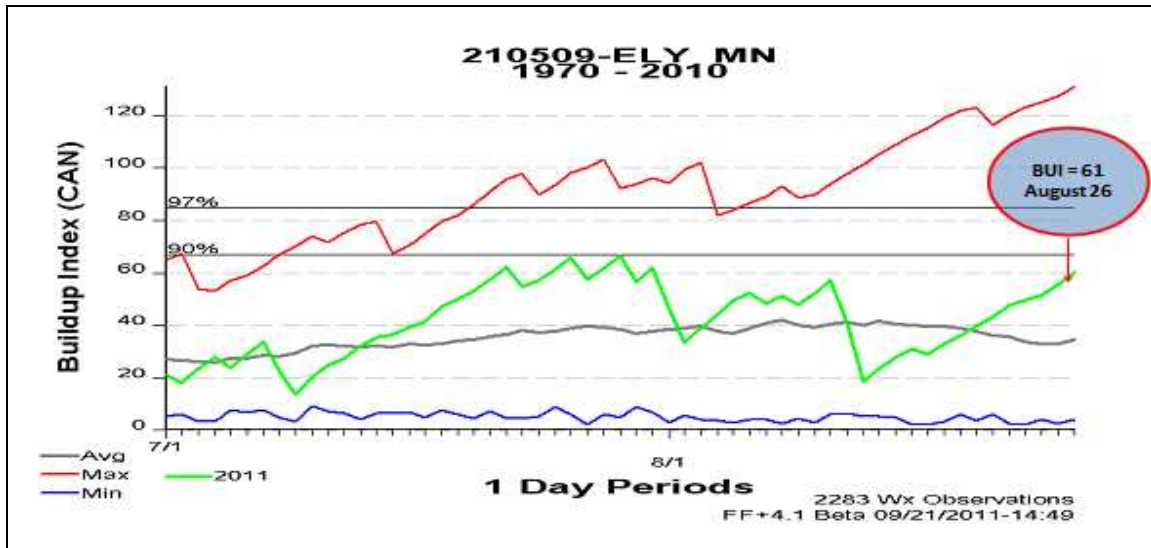


Figure 9. Build Up Index for Ely RAWS

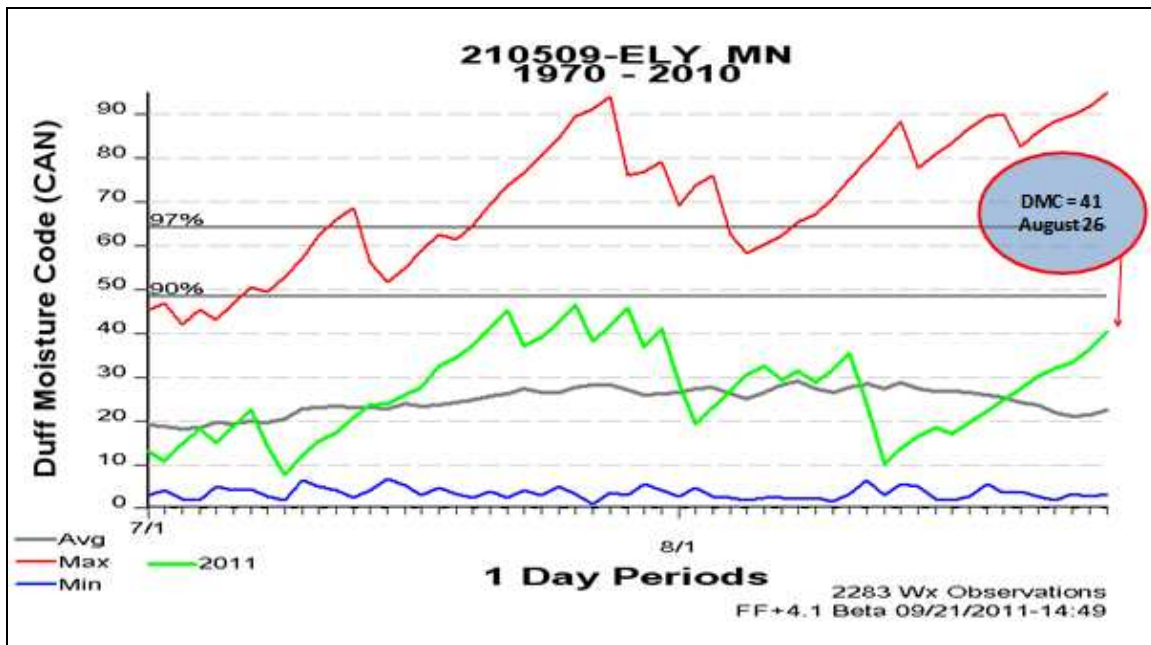


Figure 10. Duff Moisture Code for Ely RAWS

The weather forecast through September 2, 2011 called for a continued warming trend, with temperatures ranging in the mid 70's to mid 80's through the period and a chance of showers and thunderstorms each day. However, humidity and winds were not forecasted to be at values associated with large fire growth.

Fire Modeling

After mapping the fire perimeter an analysis was run to predict potential fire growth. FSPro was used to assess likelihood of fire growth in all directions from the perimeter on August 26. A simulation of 2500 fires was conducted using a

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combination of forecasted weather, climatology, and previously mapped fuel conditions to provide a generalized assessment of where fire might spread. The analysis indicates a .2-4.9% chance of fire advancing past wilderness boundary to north and 20-39% chance of fire reaching the Kawishiwi River.

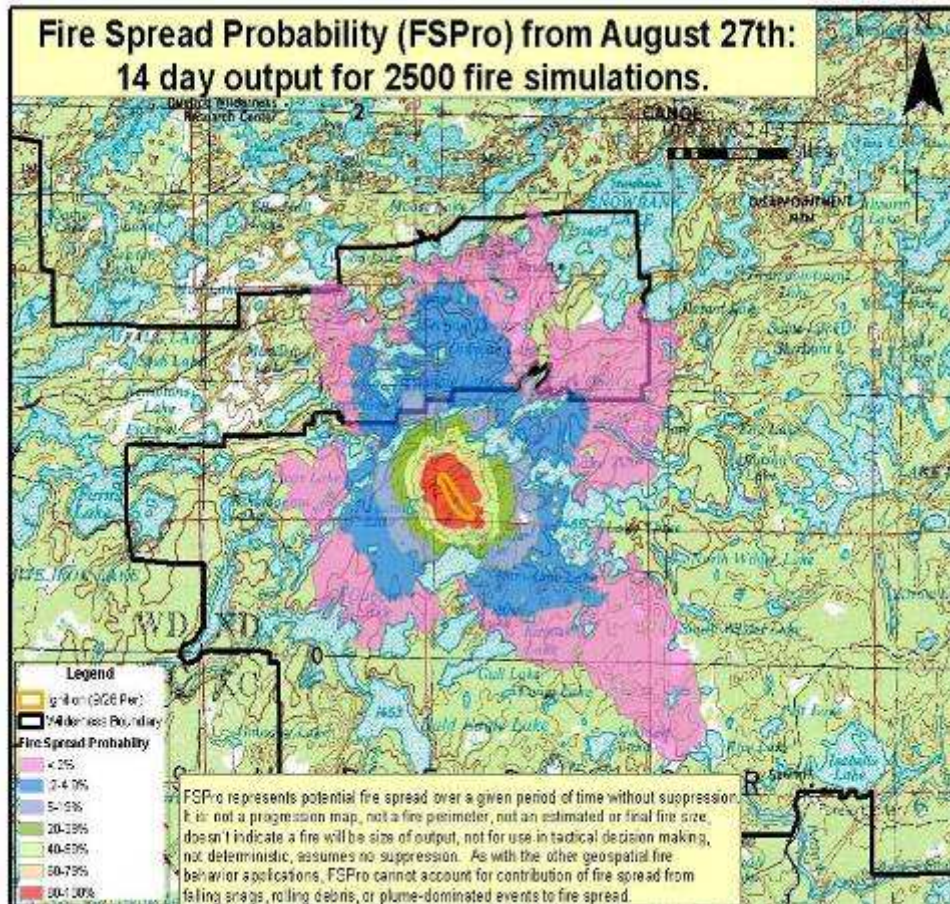


Figure 11. Fire Spread Probability map for Pagami Creek Fire. Simulated fire spread probabilities for August 27 - September 9, 2011.

A local Type III Incident Management organization was assigned on an interim basis while Forest administrators developed a new plan for management. The Type III organization was directed to contain fire spread on the north side of Pagami Creek.

Using WFDSS, a new decision was made which described how the fire would now be managed. Resources were ordered to meet the needs of the new course of action outlined in the decision. The complexity analysis in WFDSS identified that the fire was now at a level requiring a Type II incident management team (IMT2). This was based on the potential for the fire to move outside the Boundary Waters Canoe Area Wilderness (BWCAW) and increased risk to public safety, private property, and commercial timberlands. A Minnesota IMT2 was assigned. The IMT2 was tasked on August 27 to prevent fire from burning north of the wilderness boundary, protect public and private property within the Fernberg Corridor outside of the BWCAW (approximately 2-3 miles to the north). Specific

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tactics developed by the IMT2 and approved by Superior National Forest included:

- Aircraft to deliver and drop water to cease fire spread to the north
- Handcrews to construct fireline on the portion of the fire northwest of Pagami Creek
- Burnout of fuels south of Pagami Creek and east of the fire to Lake One and Lake Two.

Firing operations were delayed due to precipitation and high relative humidity that occurred in the fire area.

Date	Precipitation Amount (inches)	RAWS Station(s)
August 31	.04/.03	Ely/Fernberg/
September 1	.01/.03	Ely/Fernberg
September 2	.01	Fernberg
September 4	.02	Fernberg

Table 2. Precipitation measured at Ely and Fernberg RAWS from August 31-September 4, 2011.

While only small amounts of precipitation occurred, it was sufficient (along with high humidity) to keep fire behavior and subsequent growth very low.

Outlook issued from General Weather Forecast August 26 15:57 hours:

Scattered showers and thunderstorms will move through the region today ahead a passing cold front. Dry cool air on the back side of the front will transport from the northwest fairly rapidly late this afternoon and early evening. Temperatures were expected to increase to upper 70's to lower 80's, humidity values were to drop to lower 30's with NW winds increasing to 15-20 mph with gusts up to 25 mph. Conditions were forecasted to be short lived as temperatures were expected to become cooler and winds subside around sunset. A series of weather systems with cool moist weather were forecasted to approach during the coming week before transitioning to a slightly warmer and drying trend.

A spot forecast was requested through the Duluth National Weather Service office at 1640 hours. The forecast below is for the remainder of August 26 and for August 27, 2011 to assist with developing a new course of action.

FORECAST:

SPOT FORECAST FOR PAGAMI CREEK...USFS
NATIONAL WEATHER SERVICE DULUTH MN
502 PM CDT FRI AUG 26 2011

FORECAST IS BASED ON REQUEST TIME OF 1640 CDT ON AUGUST 26.

.DISCUSSION...GUSTY NORTHWEST WINDS AND VERY LOW RELATIVE HUMIDITY
WILL CONTINUE INTO EARLY EVENING. RELATIVE HUMIDITY LEVELS WILL
REMAIN IN THE 25 PERCENT RANGE UNTIL AFTER 7PM.

FAIR WEATHER IS ANTICIPATED SATURDAY WITH RAIN CHANCES INCREASING

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SUNDAY INTO MONDAY. MORE RAIN IS LIKELY TUESDAY AFTERNOON OR EVENING.

.TONIGHT...

SKY/WEATHER.....MOSTLY CLEAR. PATCHY FOG AFTER MIDNIGHT.
MIN TEMPERATURE.....46-51.
MAX HUMIDITY.....85 PERCENT.
WIND (20 FT).....NORTHWEST WINDS 8 TO 12 MPH BECOMING LIGHT.
MIXING HEIGHT.....1050 FT AGL.
TRANSPORT WINDS.....NORTHWEST 10 TO 15 MPH.
SMOKE DISPERSAL.....EXCELLENT (76900) DECREASING TO POOR (2000) IN
THE LATE EVENING AND OVERNIGHT.

TIME (CDT)	7 PM	9 PM	11 PM	1 AM	3 AM	5 AM
TEMP.....	76	61	56	53	51	50
RH.....	34	58	66	74	77	80
20 FT WIND DIR..	NW	NW	NW	NW	NW	NW
20 FT WIND SPD..	11	8	6	4	3	3
20 FT WIND GUST.	20	15	12	5		

.SATURDAY...

SKY/WEATHER.....MOSTLY SUNNY.
MAX TEMPERATURE.....69-74.
MIN HUMIDITY.....42 PERCENT.
WIND (20 FT).....LIGHT WINDS BECOMING NORTHWEST 3 TO 7 MPH.
MIXING HEIGHT.....300 FT AGL INCREASING TO 3500 FT AGL LATE IN
THE MORNING...THEN INCREASING TO 6900 FT AGL
EARLY IN THE AFTERNOON DECREASING TO 4800 FT
AGL LATE IN THE AFTERNOON.
TRANSPORT WINDS.....NORTHWEST 5 TO 10 MPH.
SMOKE DISPERSAL.....GOOD (50100).

TIME (CDT)	7 AM	9 AM	11 AM	1 PM	3 PM	5 PM
TEMP.....	49	57	64	69	72	71
RH.....	85	69	56	45	42	46
20 FT WIND DIR..	NW	N	NW	W	NW	NW
20 FT WIND SPD..	2	3	5	6	6	5
20 FT WIND GUST.		6	8	8	7	

Additional analyses were conducted on September 1 to reassess and validate current fuel conditions and potential for fire growth. Fire Spread Probability FSPro was used to simulate fire growth. The forecasted weather from the Incident Meteorologist was used for the first 3 days of both FSPro analyses. Beyond 3 days, historical weather data (averages for late August-early September) was used from the Ely RAWS. This analysis was based on an extensive series of calibration analyses of the fire's behavior, especially on August 26th.

BURNOUT OPERATIONS – SEPTEMBER 4-6, 2011

Burnout Operations – September 3-6

The south portion of the original 135 acre fire was a mass of small spot fires. At least one of these moved into more flammable fuel (jack pine ridges) and started moving west and then east as winds shifted with overall movement to the south. Fuel continued to dry out and fire intensity increased. Individual trees and small groups occasionally torched in the afternoons. Rates of spread were slow (<5 chains per hour) for much of this period.



Figure 12. September 4 at 17:29. Helicopter with torch burning out area SW of Lake One-Lake Two Portage. Looking NE with Lake Two on the right.

The burnout on September 4 and 5 had provided a barrier to fire spread between Lake One, Lake Two and the east perimeter of the spot fires from the August 26th fire run. The southernmost of the August 26th spot fires remained active on its southern perimeter. The burnout had stopped moving south along a wet lowland that extended east from the southernmost spot fire to Rock Island Lake (see map in Figure 15). The east perimeter of the burnout was contained by Lake Two and the stream connecting Rock Island Lake with Lake Two. A large unburned area remained to the south of Pagami Creek.

Additional burnout was planned for September 6th to consolidate the spot fires from the August 26th fire run and fill in the unburned area south of Pagami Creek. The burnout operation was successful in consolidating most of the remaining spot fires and providing a barrier to fire spread to the north and east.

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Figure 13. Looking south at the burnout operation along south side of Pagami Creek.

The west flank of the August 26th fire perimeter continued to burn freely. There was concern by the IMT2 and the Superior National Forest that fire could move from the west flank and then with southerly winds make run toward the Fernberg Corridor to the north. The southernmost spot of the August 26th burn area began moving to the south.



Figure 14. Looking south with the burnout operation is in the foreground. The single smoke to the right was ignited next to a riparian area. A red arrow points to the southernmost spot fire from the August 26th fire run in the upper middle. The original fire had become active and was starting to move to the south.

Pagami Creek Decision Support Narrative

Consequently, additional firing along that flank was planned to bring the fire to wetlands and streams to avoid a crown fire run that might spot across those wet areas under more severe fire weather. The additional burnout occurred on September 6th and the resultant perimeter is shown in the map in Figure 14

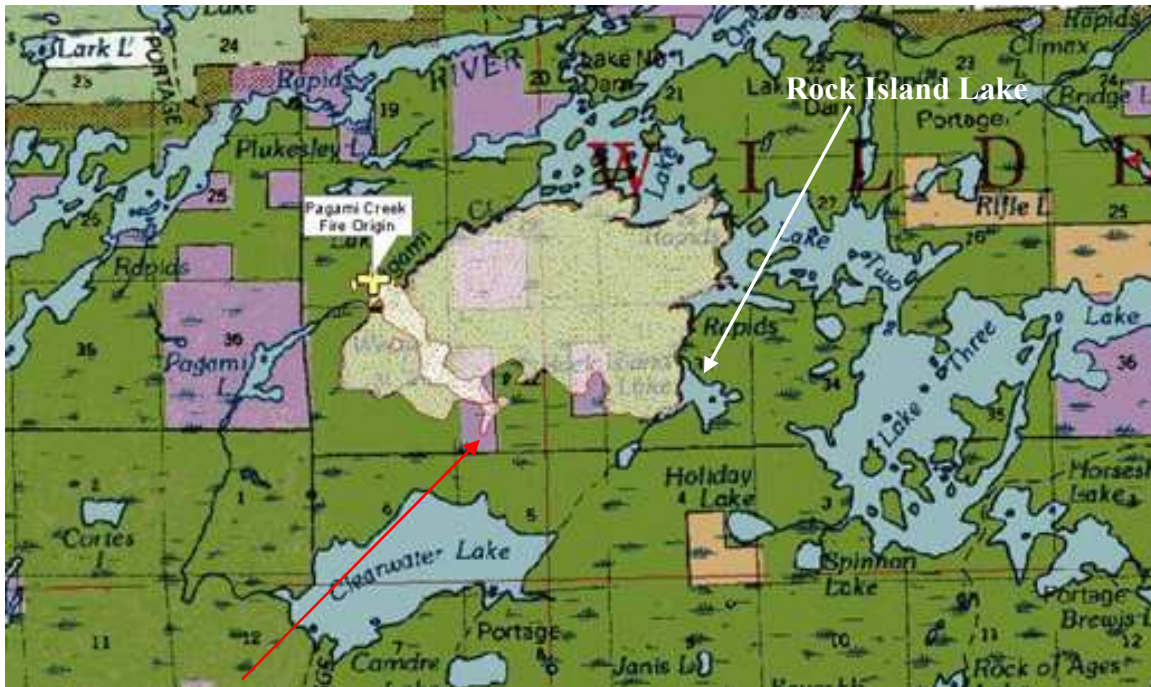


Figure 15. Fire perimeter evening of September 7th. The southernmost spot fire from the August 26th run (red arrow) had moved several hundred yards to the SW.

Pagami Creek Decision Support Narrative



Figure 16. Fire perimeter evening of September 9th. The southernmost spot fire from the August 26th run had moved several hundred yards to the SW. NW winds on the 8th and 9th pushed the southern perimeter past Clearwater Lake to the south and to Holiday Lake to the east.

Fire Behavior and Fire Growth September 7 through September 10

The fire continued burning with low to moderate fire intensity and spread rates through the period. The area burned in the firing operation gradually lost intensity and transitioned to smoldering fire behavior within a couple of days of ignition. The following FSPro run was completed on September 8. The Ely RAWS was used for fuel moistures and wind. This run was predicted fire spread through September 15, 2011.



Figure 17. Pagami Creek Fire FSPro run 9/8-9/15/2011 with first 3 days of forecast (gridded) weather and remaining days with historic weather and wind from Ely RAWS (1990-2010).

Pagami Creek Decision Support Narrative

By the end of the day on September 9th, the fire had already moved south of the lowest probability identified in the modeling exercise displayed above. Fire spread from the southern spot fires of the original 135 acre perimeter had brought fire to a riparian area south and west of Judd Lake.

A new modeling exercise was begun to provide a more realistic assessment of potential fire spread to the south. The new FSPro run (displayed below) was completed on September 9 and displayed fire spread probabilities for the next seven days.

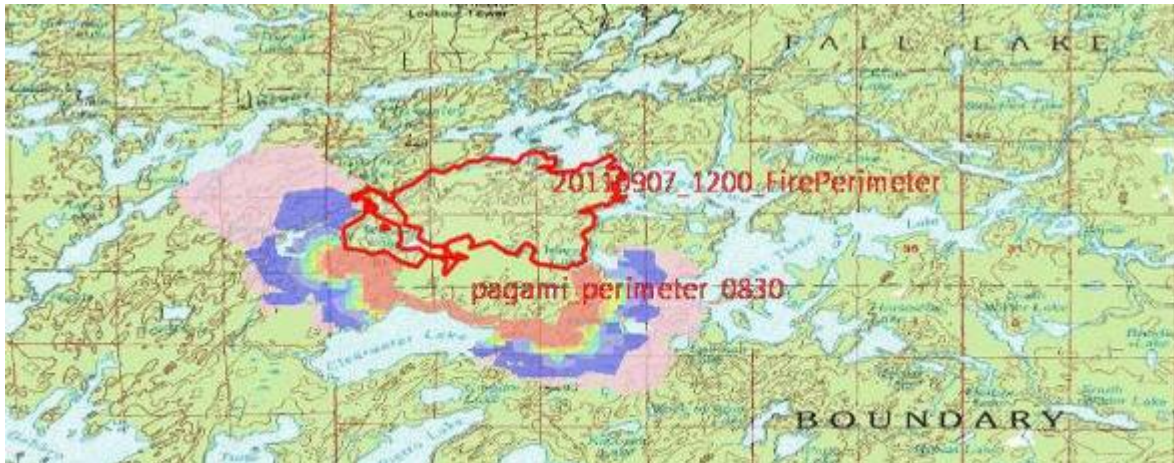


Figure 18. FSPro run for September 9-16.

SEPTEMBER 10, 2011



Figure 19. Photo taken from Beaver One 1900 hrs September 10.

Pagami Creek Decision Support Narrative

On the morning of September 10, relative humidity dropped very quickly from 85% at 0800 to less than 30% by 1100. Winds shifted from easterly to southerly and finally northwesterly by mid afternoon.

The fire responded to these weather conditions by moving to the west-southwest. During the late morning and early afternoon the fire made runs of up to one mile to the south, southwest and southeast. The morning-early afternoon fire growth presented a long flank for the afternoon wind shift. The long flank oriented NW to SE became the head of the fire and made a sustained run to the east. Fire behavior was characterized as active surface, with torching and short crown fire runs. Prolific short range spotting enhanced fire growth.

By about 1800 the fire was raining embers at the Pow Wow trailhead near Horseshoe Lake. The fire reached the trailhead by the end of the day.



Figure 20. Approximate fire perimeter late afternoon on September 10, 2011

The firing operation completed September 4-6 coupled with the handline completed around the fire area north of Pagami Creek provided barriers to prevent spread to the north toward the Fernberg Corridor.

Below is the spot weather forecast issued for September 10 followed by actual observations collected from Ely and Fernberg RAWS stations for comparison.

Pagami Creek Decision Support Narrative

WINDS WILL GENERALLY BE OUT OF THE SOUTHWEST...WITH A FEW GUSTS AROUND 15 MPH POSSIBLE DURING THE AFTERNOON. MINIMUM RH WILL DROP TO NEAR 20 PERCENT THIS AFTERNOON

SKY/WEATHER.....MOSTLY SUNNY.

MAX TEMPERATURE.....81-86.

MIN HUMIDITY.....19-24 PERCENT.

WIND (20 FT).....LIGHT WEST WIND THROUGH 1200...BECOMING SOUTHWEST 4 TO 9 MPH IN THE AFTERNOON. A FEW GUSTS 12 TO 16 MPH POSSIBLE AFTER 1300.

MIXING HEIGHT.....7300 FT AGL INCREASING TO 9600 FT AGL EARLY IN THE AFTERNOON...THEN DECREASING TO 8800 FT AGL LATE IN THE AFTERNOON.

TRANSPORT WINDS.....NORTH AROUND 0 MPH BECOMING WEST AROUND 5 MPH IN THE AFTERNOON.

SMOKE DISPERSAL.....POOR (11600) INCREASING TO GOOD (42400).

TIME (CDT)	11 AM	1 PM	3 PM	5 PM
TEMP.....	81	79	83	82
RH.....	26	20	20	23
20 FT WIND DIR..	W	SW	SW	SW
20 FT WIND SPD..	4	8	9	8
20 FT WIND GUST.	9	14	15	12

Observations acquired from Ely and Fernberg RAWS location September 10

Ely RAWS	Temp °F	RH %	Wind Speed	Wind Gust	Direction °
0100 hrs	53	96	2	5	142
0200 hrs	52	96	1	2	142
0300 hrs	50	100	3	4	142
0400 hrs	49	100	0	6	142
0500 hrs	48	100	0	0	ND
0600 hrs	48	100	2	3	142
0700 hrs	56	92	2	3	142
0800 hrs	66	77	1	3	142
0900 hrs	75	51	4	5	213
1000 hrs	80	41	5	8	248
1100 hrs	82	34	7	11	217
1200 hrs	84	33	5	11	239
1300 hrs	85	31	7	16	218
1400 hrs	86	31	8	15	233
1500 hrs	86	30	7	15	246
1600 hrs	85	32	8	16	238
1700 hrs	83	34	9	17	250
1800 hrs	80	39	7	12	235
1900 hrs	75	47	7	11	225
2000 hrs	71	56	5	9	224
2100 hrs	69	64	5	7	244
2200 hrs	65	72	5	6	228
2300 hrs	63	78	6	9	216
2400 hrs	62	82	5	8	232

Pagami Creek Decision Support Narrative

Fernberg RAWS	Temp °F	RH %	Wind Speed	Wind Gust	Direction °
0100 hrs	63	71	3	6	179
0200 hrs	64	67	3	4	177
0300 hrs	64	71	2	4	167
0400 hrs	59	80	4	5	165
0500 hrs	60	79	4	5	170
0600 hrs	62	76	2	4	186
0700 hrs	61	85	3	4	178
0800 hrs	73	44	3	5	176
0900 hrs	77	39	3	6	161
1000 hrs	81	26	4	9	301
1100 hrs	85	26	5	10	282
1200 hrs	85	28	7	11	294
1300 hrs	88	25	5	11	267
1400 hrs	88	25	6	14	285
1500 hrs	88	24	5	14	233
1600 hrs	86	24	5	13	277
1700 hrs	82	30	6	12	278
1800 hrs	78	35	3	10	263
1900 hrs	74	42	3	9	237
2000 hrs	73	48	3	11	245
2100 hrs	71	54	5	10	263
2200 hrs	69	59	4	11	271
2300 hrs	65	69	3	8	207
2400 hrs	64	71	4	9	225

Table 3. Ely and Fernberg RAWS hourly observations for September 10, 2011.

Environmental conditions supporting intense burning conditions extended into the early evening due to several factors including: very dry air aloft and humidity values under 35% for ~ 8 hours (recorded at Fernberg RAWS). Exact growth and location of portions of the fire perimeter was not known due to very smoky conditions. Later interviews with Public Safety personnel (who had cleared the Pow Wow trail) provided information about the extent of fire growth that day.

However, because the fire had spread to south and then east toward Lake Three, it was decided by the IMT and the Kawishiwi District Ranger to clear all visitors, public safety personnel and firefighters from all areas in the Lake One-Two-Three-Four chain, Hudson Lake, and the southern portion of Insula Lake..

Pagami Creek Decision Support Narrative

SEPTEMBER 11, 2011

The fire burned with low intensity through the early morning hours and spread was limited as winds subsided and humidity increased during the overnight period.

The weather forecast called for gusty southwest winds in the morning, shifting to NW in the afternoon with low humidity expected. The amount of open fireline (2-3 miles) created a potential alignment for substantial growth. By 1000 hours the humidity began declining and winds increased from the west northwest. This NW wind shift occurred earlier than expected. By 1145, fire around Kayoskh Lake began to gain intensity and move to the southeast.

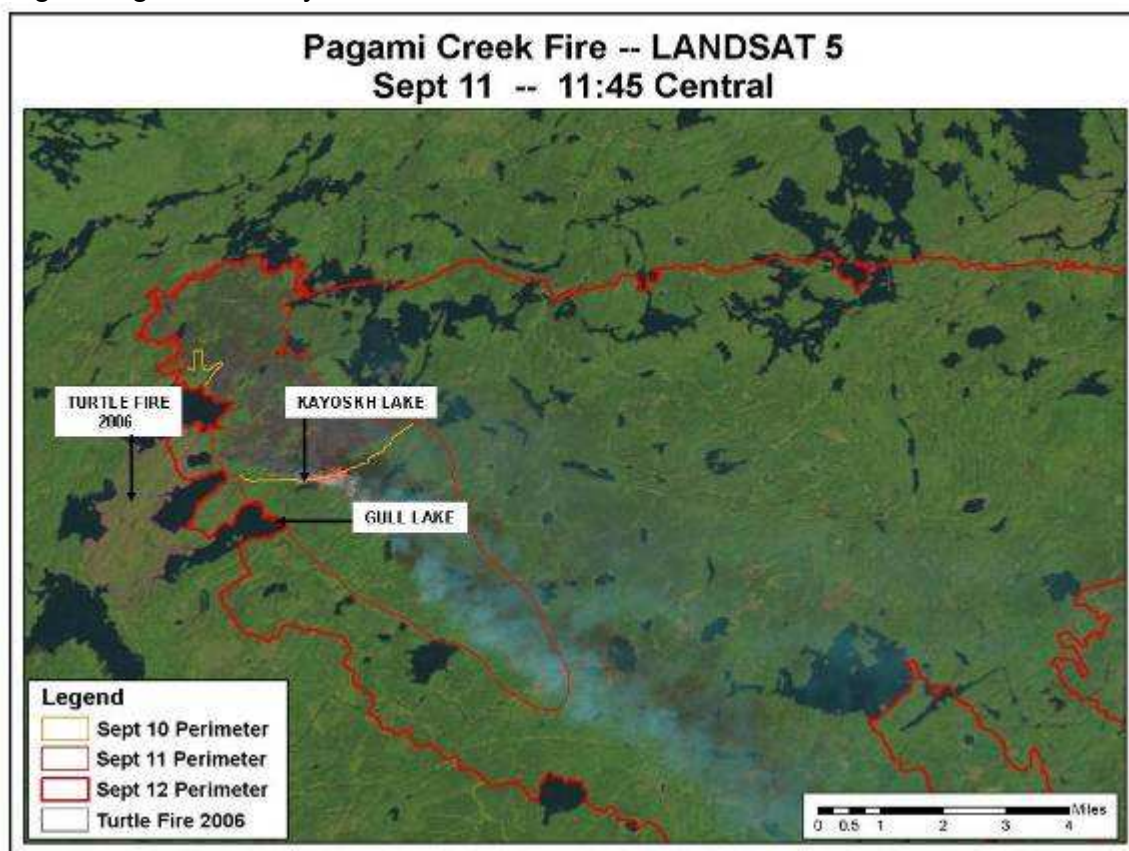


Figure 21. Map displaying fire progression at approximately 1145 hrs on September 11. Intense heat signature depicted by LANDSAT 5 imagery shows fire had burned southeast to Kayoskh Lake.

SPOT FORECAST FOR PAGAMI CREEK...USFS
NATIONAL WEATHER SERVICE DULUTH MN
319 PM CDT SAT SEP 10 2011

FORECAST IS BASED ON REQUEST TIME OF 1447 CDT ON SEPTEMBER 10.

.DISCUSSION...A SLOW MOVING COLD FRONT WILL APPROACH THE REGION
TOMORROW. AHEAD OF THE FRONT...A WIND SHIFT LINE WILL DEVELOP. WINDS

Pagami Creek Decision Support Narrative

WILL GRADUALLY INCREASE AND SHIFT FROM SOUTHWEST...IN THE MORNING...TO NORTHWEST IN THE AFTERNOON. LOCALLY GUSTY WINDS SHOULD DEVELOP IN THE AFTERNOON AND CONTINUE INTO THE EARLY EVENING. MINIMUM RELATIVE HUMIDITY WILL DROP INTO THE LOW TO MID 20S BY NOON. THE ACTUAL FRONT WILL STALL NORTH OF THE BORDER TOMORROW NIGHT...ALLOWING LIGHT SOUTHEAST AND EAST WINDS TOMORROW NIGHT. THE FRONT WILL CHARGE ACROSS THE AREA MONDAY AFTERNOON WITH AN ABRUPT SHIFT IN WIND DIRECTION AND A FEW SHOWERS...POSSIBLY A THUNDERSTORM.

.TONIGHT...

SKY/WEATHER.....MOSTLY CLEAR. PATCHY FOG AFTER MIDNIGHT.

MIN TEMPERATURE.....54-59.

MAX HUMIDITY.....72 PERCENT.

WIND (20 FT).....SOUTHWEST WINDS 3 TO 4 MPH EARLY IN THE EVENING
BECOMING LIGHT.

MIXING HEIGHT.....4100 FT AGL DECREASING TO 300 FT AGL IN THE
LATE EVENING AND OVERNIGHT.

TRANSPORT WINDS.....SOUTHWEST 10 TO 15 MPH.

SMOKE DISPERSAL.....GOOD (32100) DECREASING TO POOR (2150) IN THE
LATE EVENING AND OVERNIGHT.

TIME (CDT)	7 PM	9 PM	11 PM	1 AM	3 AM	5 AM
TEMP.....	80	69	64	62	60	58
RH.....	29	42	54	62	64	69
20 FT WIND DIR..	W	SW	SW	SW	SW	SW
20 FT WIND SPD..	4	3	2	1	0	0
20 FT WIND GUST.	5					

.SUNDAY...

SKY/WEATHER.....SUNNY THEN BECOMING PARTLY CLOUDY.

MAX TEMPERATURE.....83-88.

MIN HUMIDITY.....22-27 PERCENT.

WIND (20 FT).....LIGHT WINDS BECOMING WEST 4 TO 8 MPH IN THE
MORNING...THEN BECOMING NORTHWEST 10 TO 15 MPH IN
THE AFTERNOON....GUSTS TO 20 MPH.

MIXING HEIGHT.....400 FT AGL INCREASING TO 8850 FT AGL.

TRANSPORT WINDS.....NORTHWEST 15 TO 20 MPH.

SMOKE DISPERSAL.....POOR (4300) INCREASING TO EXCELLENT (139700).

TIME (CDT)	7 AM	9 AM	11 AM	1 PM	3 PM	5 PM
TEMP.....	57	65	80	85	86	84
RH.....	69	50	30	29	24	27
20 FT WIND DIR..	W	W	W	W	NW	NW
20 FT WIND SPD..	1	4	6	10	12	12
20 FT WIND GUST.		5	12	16	20	2

Observations acquired from Ely and Fernberg RAWS locations September 11, 2011. Hours highlighted in yellow indicate critical burn period that support crown fire activity. Observations from the IMT2 Fire Behavior Analyst (FBAN) noted that crown fire initiation began around 1100 hours and continued until approximately 1900 hours (8 hour critical burn period).

Pagami Creek Decision Support Narrative

Ely RAWS Sept 11	Temp °F	RH %	Wind Speed	Wind Gust	Direction °
0100 hrs	63	78	6	9	215
0200 hrs	62	82	5	8	215
0300 hrs	60	89	5	7	215
0400 hrs	60	89	5	7	215
0500 hrs	59	91	6	8	215
0600 hrs	58	92	6	7	215
0700 hrs	57	95	6	8	215
0800 hrs	62	90	6	9	215
0900 hrs	68	77	8	12	245
1000 hrs	75	59	8	13	245
1100 hrs	78	46	13	20	270
1200 hrs	80	46	9	21	315
1300 hrs	81	41	11	20	315
1400 hrs	84	30	10	20	335
1500 hrs	84	25	10	20	315
1600 hrs	83	24	11	21	335
1700 hrs	83	27	8	19	335
1800 hrs	80	30	8	16	335
1900 hrs	77	30	8	16	335
2000 hrs	67	42	1	5	335
2100 hrs	60	64	2	4	335
2200 hrs	57	69	2	2	335
2300 hrs	54	80	1	5	335
2400 hrs	52	81	1	2	335

Table 4. Ely RAWS hourly observations for September 11, 2011.

Fernberg RAWS Sept 11	Temp °F	RH %	Wind Speed	Wind Gust	Direction °
013 hrs	65	69	3	8	207
113 hrs	64	71	4	9	225
213 hrs	63	75	3	8	222
313 hrs	62	78	4	12	224
413 hrs	62	79	5	11	234
513 hrs	61	82	4	10	217
613 hrs	60	86	4	10	215
713 hrs	60	85	4	10	226
813 hrs	66	69	5	14	252
913 hrs	72	55	5	14	269
1013 hrs	76	48	6	14	292
1113 hrs	80	39	8	17	293
1213 hrs	81	36	11	19	310

Pagami Creek Decision Support Narrative

1313 hrs	83	25	12	20	311
1413 hrs	84	23	11	21	324
1513 hrs	83	24	12	21	313
1613 hrs	84	21	14	22	311
1713 hrs	83	24	9	22	317
1813 hrs	79	24	9	17	319
1913 hrs	75	28	6	15	318
2013 hrs	71	32	6	9	306
2113 hrs	70	33	5	9	321
2213 hrs	68	36	2	6	57
2313 hrs	68	35	4	6	87

Table 5. Fernberg RAWS hourly observations for September 11, 2011.



Figure 22. Photo Taken from Ely at 1500 hours on September 11

The graphs below are windrose summaries for Ely, Fernberg, Isabella and Seagull RAWS locations. The observations are hourly captions for September 11, 2011. Ely, Fernberg and Isabella display predominant winds from the northwest. Seagull RAWS shows a stronger southwest wind. Observations are both 10 minute average and gust recorded for each hour.

Pagami Creek Decision Support Narrative

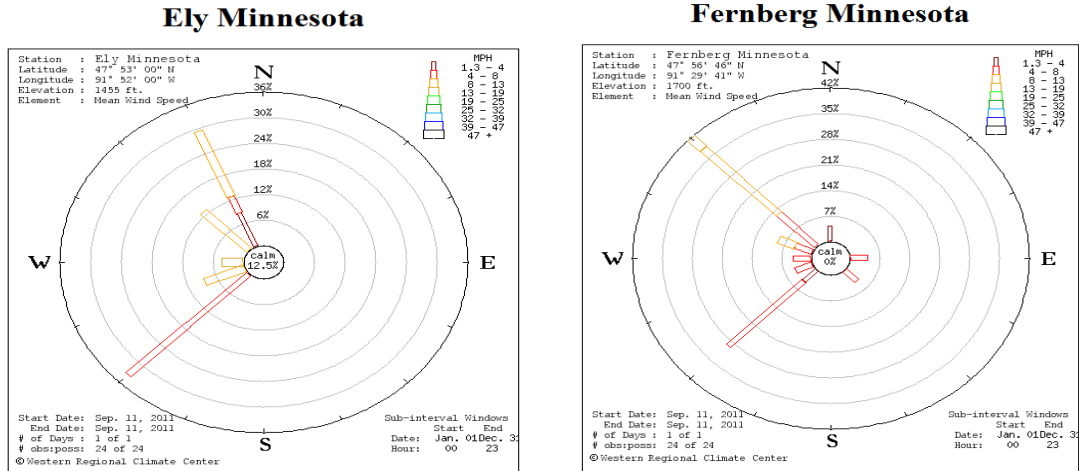


Figure 23. "Wind rose" for Ely and Fernberg RAWs displaying historical frequencies of wind direction and wind speed for September 11 (period of record 1970-2011).

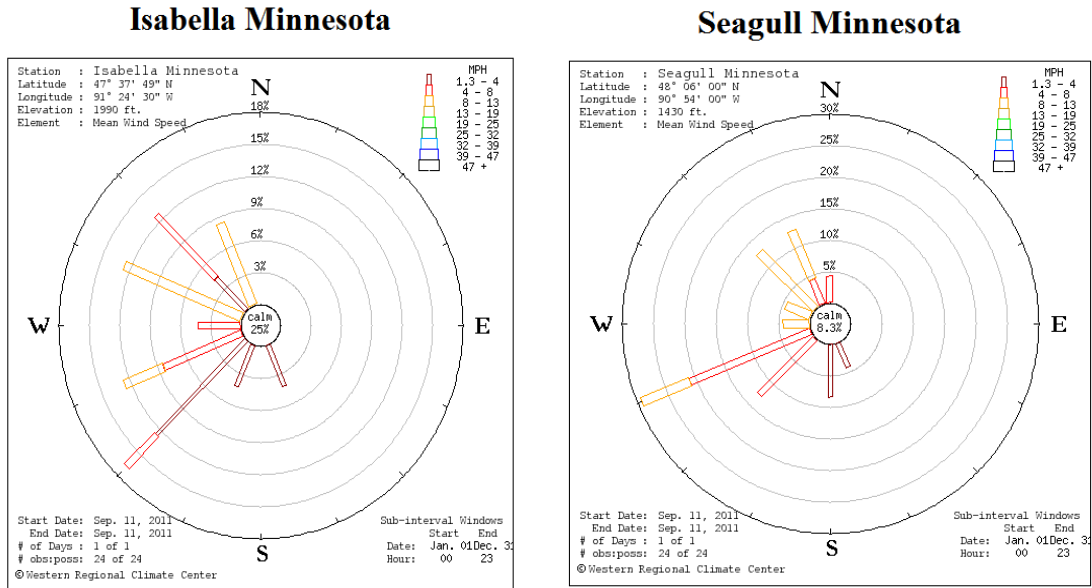


Figure 24. "Wind rose" for Isabella and Seagull RAWs displaying historical frequencies of wind direction and wind speed for September 11 (period of record 1970-2011).

The fire behavior was characterized by intense surface fire, prolific spotting and sustained crown runs. The fire had progressed southeast burning beyond the Quadga Lake area and continued over the Isabella River. Fire behavior continued to be active through the late evening and morning hours as humidity values recorded at Fernberg RAWs remained around 40%.

Pagami Creek Decision Support Narrative

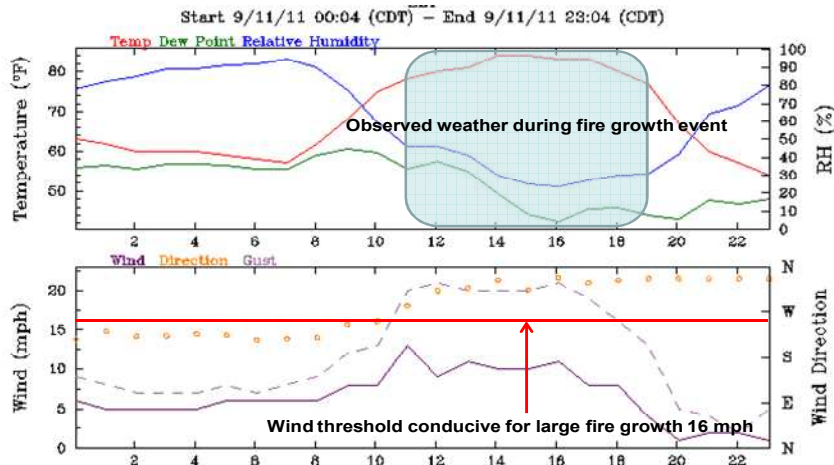


Figure 25 . Temperature and wind observations for September 11, 2011 at Fernberg RAWS.



Figure 26. View looking northwest showing fire burning up to east shores of Quagda Lake, photo taken at 1906 hours September 11 from Beaver One.

Forest agency administrators and the IMT2 reaffirmed the decision of the previous night (September 10) to clear all visitors, public safety personnel and firefighters from the area south and east of Quagda Lake, Forest Center, and to the northeast as far as “The Rock”, a prominent island in the northern part of Lake Insula. The intent was to ensure nobody remained in those areas after noon on September 12.

SEPTEMBER 12, 2011

On the morning of September 12, the fire began actively spreading by 1000 hours and by 1145 hours the east flank had three distinct columns. The areas that had the most intensity as depicted by LANDSAT 7 and SPOT satellite imagery 1145 hours show intense heat around Horseshoe, Diana and Pioneer Lakes. The heat signature and smoke column show a southwesterly flow over the fire.



Figure 27. This photo was taken September 12 at approximately 1100 hours from Beaver Aircraft looking east between Gull and Pietro Lakes.

Pagami Creek Decision Support Narrative

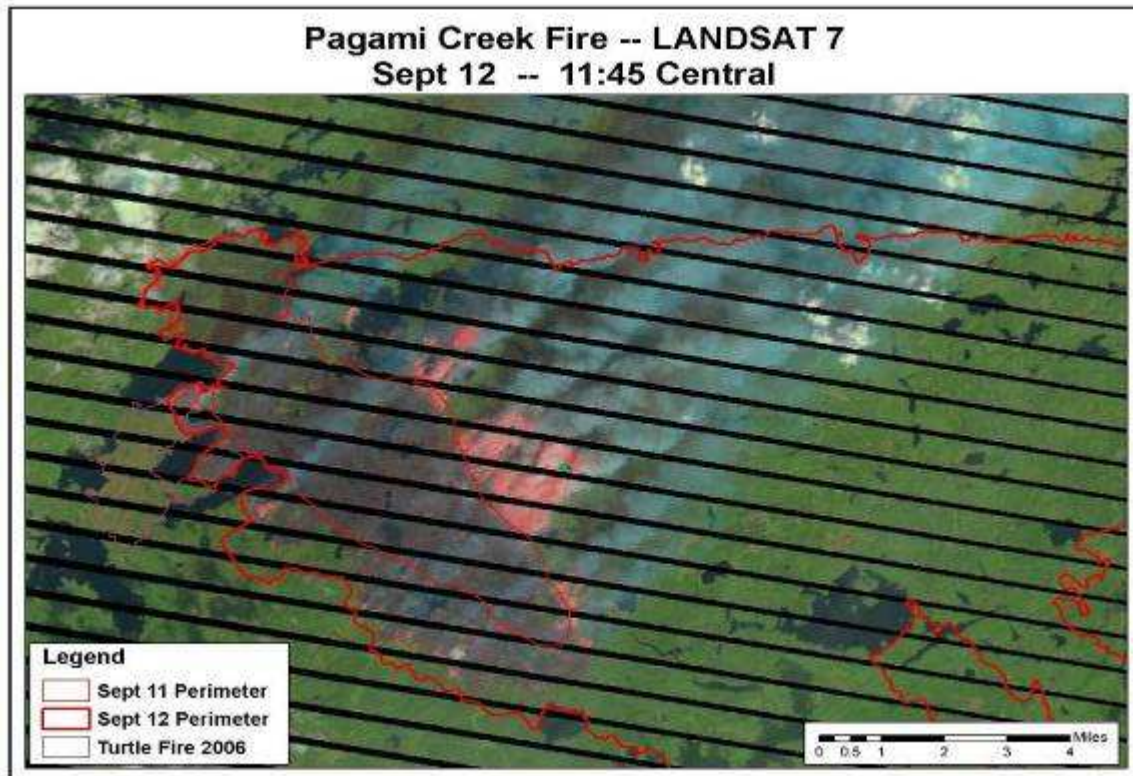


Figure 28. Landsat 7 imagery taken at 1145 Central on September 12, 2011.

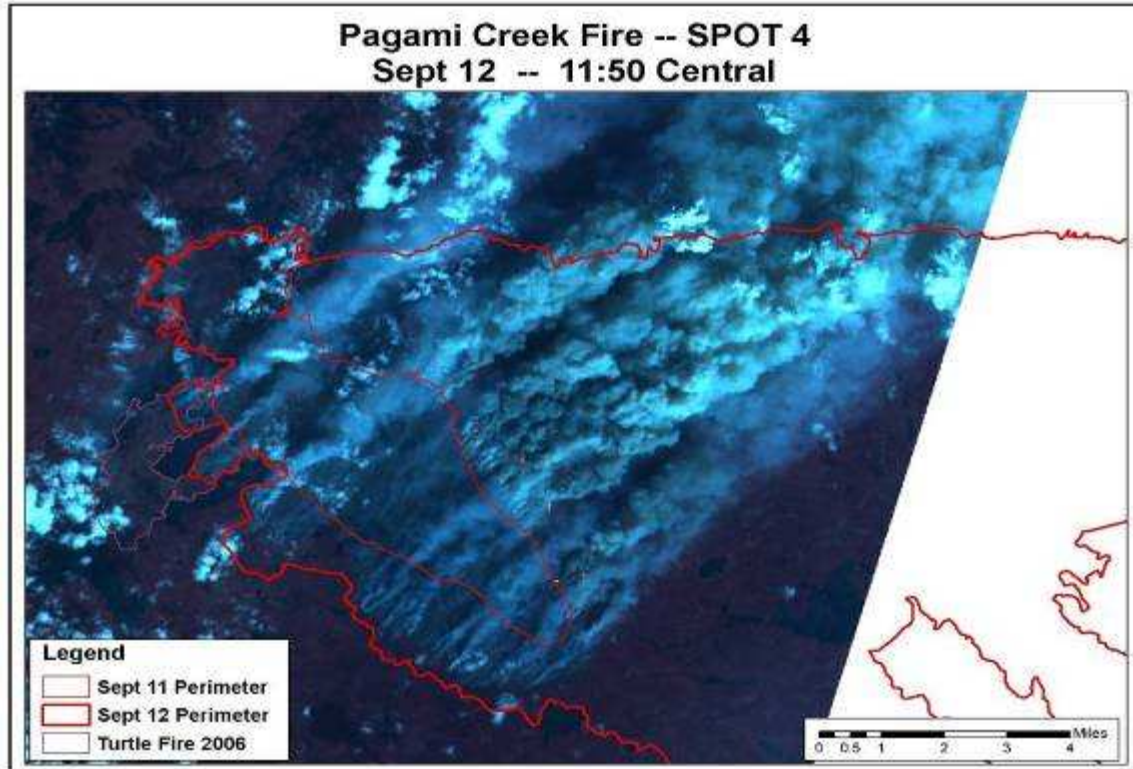


Figure 29. SPOT satellite imagery over the Pagami Creek Fire on September 12, 2011 at 1150 Central Time.

Pagami Creek Decision Support Narrative

Note the smoke plume in the SPOT satellite imagery above. It was impossible for fire managers to know with any degree of precision where the flaming front of the fire was located. Very dense smoke obscured surface conditions for miles beyond the head of the fire throughout the remainder of the day.

Between 1145 and 1350 the fire was burning in 150-year-old boreal forest with increasing amounts of blowdown as it neared Lake Insula. Winds increased to 18 mph from the SW (Ely RAWS).

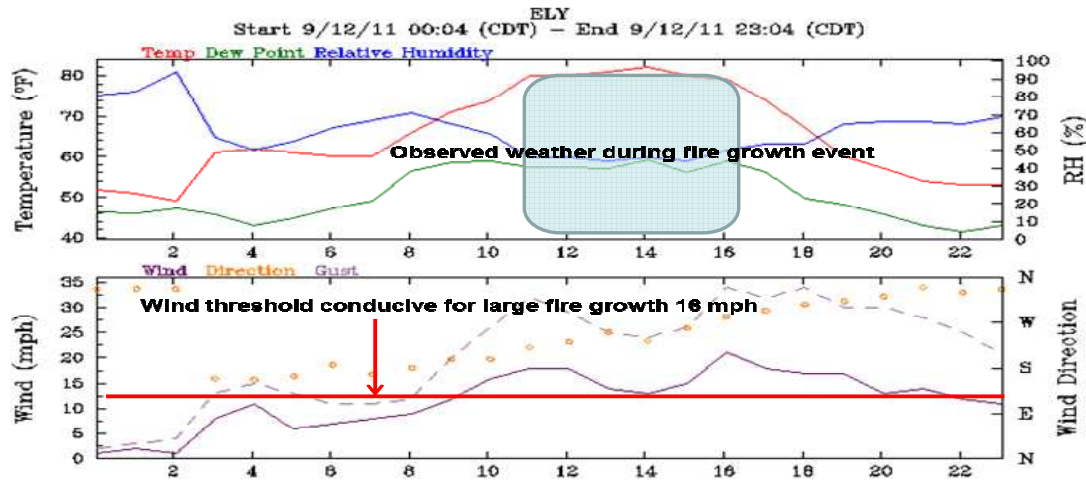


Figure 30. Temperature and wind observations for September 12, 2011 at Ely RAWS.

The following table displays weather observations taken from Ely and Fernberg RAWS for September 12, 2011. The time, wind speed and gust speed are highlighted in yellow indicating time of major run. Byron Paulson – Incident Meteorologist suggests that the Ely RAWS would be a better representative of the winds that were observed on the Pagami Creek Fire.

Ely RAWS Sept 12	Temp °F	RH %	Wind Speed	Wind Gust	Direction °
0004 hrs	52	81	1	2	335
0104 hrs	51	83	2	3	335
0204 hrs	49	94	1	4	335
0304 hrs	61	57	8	13	160
0404 hrs	62	50	11	15	160
0504 hrs	61	55	6	13	160
0604 hrs	60	63	7	11	180
0704 hrs	60	67	8	11	160
0804 hrs	66	71	9	12	180
0904 hrs	71	65	12	20	225
1004 hrs	74	59	16	26	225
1104 hrs	80	46	18	32	225
1204 hrs	80	46	18	29	225

Pagami Creek Decision Support Narrative

1304 hrs	81	44	14	25	245
1404 hrs	82	46	13	24	225
1504 hrs	80	44	15	26	270
1604 hrs	79	50	21	34	270
1704 hrs	74	54	18	32	300
1804 hrs	67	54	17	34	315
1904 hrs	60	65	17	30	315
2004 hrs	57	66	13	30	315
2104 hrs	54	66	14	28	340
2204 hrs	53	65	12	25	340
2304 hrs	53	69	11	21	340

Table 6. Hourly weather observations at Ely RAWs on September 12, 2011.

Fernberg RAWS Sept 12	Temp °F	RH %	Wind Speed	Wind Gust	Direction °
013 hrs	64	40	4	7	135
113 hrs	62	45	5	8	160
213 hrs	64	41	7	13	135
313 hrs	64	41	8	19	160
413 hrs	63	46	7	14	135
513 hrs	61	48	6	14	180
613 hrs	61	51	6	10	135
713 hrs	64	55	6	11	180
813 hrs	68	58	6	14	180
913 hrs	72	53	9	18	180
1013 hrs	76	45	11	21	180
1113 hrs	84	35	8	24	210
1213 hrs	85	34	8	27	225
1313 hrs	85	35	8	24	270
1413 hrs	85	35	6	27	270
1513 hrs	81	39	13	27	340
1613 hrs	74	59	16	28	340
1713 hrs	73	50	17	37	315
1813 hrs	66	58	18	37	315
1913 hrs	60	63	18	35	315
2013 hrs	55	68	18	36	315
2113 hrs	52	63	19	32	340
2213 hrs	52	64	ND	ND	ND
2313 hrs	51	65	ND	ND	ND

Table 7. Hourly weather observations at Fernberg RAWs on September 12, 2011.

Pagami Creek Decision Support Narrative

Following are weather factors associated with Pagami Creek Fire behavior on September 12, 2011 as identified by Byron Paulson – Incident Meteorologist and National Weather Service Fire Weather Forecaster Twin Cities/Chanhassen, Minnesota.

The atmosphere was unstable. Altocumulus-Castellanus clouds were noted in several photos taken. These clouds indicate atmospheric instability. In addition, the 12z sounding taken at International Falls on 9/12 showed a very unstable atmosphere. Above a shallow morning inversion, lapse rates were about 4.5 degrees Fahrenheit per 1000 feet through 10,000 feet which is near the dry adiabatic of 5.5 degrees per 1000 feet. When the temperature gradient is this large a parcel of heated air (from surface heating by the sun or from heating by a fire) will rise rapidly. During a wildfire, rapidly rising heated air contributes to large convection column development. Large convection columns create strong surface winds to replace the air rising in the column. The strong winds increase fire intensity in a positive feedback cycle driving the fire faster and more intensely until it runs out of fuel or the weather significantly changes.

There was a **wind profile** present on the International Falls 12z (0500 Central Time) sounding that would have been favorable for supporting a thunderstorm with a strong, rotating updraft. The wind data showed wind varying from 220 degrees to 265 degrees as altitude is gained. This fairly long shear should have aided the development of a convective column just as it would a thunderstorm. As mentioned previously, strong convection column development creates strong surface winds further increasing fire intensity. A rotating column contributes to gustiness and

Strong gradient winds (sustained winds of 15 to 25 mph with gusts of 25 to 35 mph) aided in rapid fire spread and long range spotting.

Haines Index – Plume dominated fires are associated with a High Haines Index, but in an environment of typically relatively light winds. The Pagami Creek Fire spread in an environment of Moderate to High Haines Index, but very strong winds. It appeared to have been a combination of wind driven and plume dominated fire movement as a result of the weather factors observed September 12.

Pagami Creek Decision Support Narrative

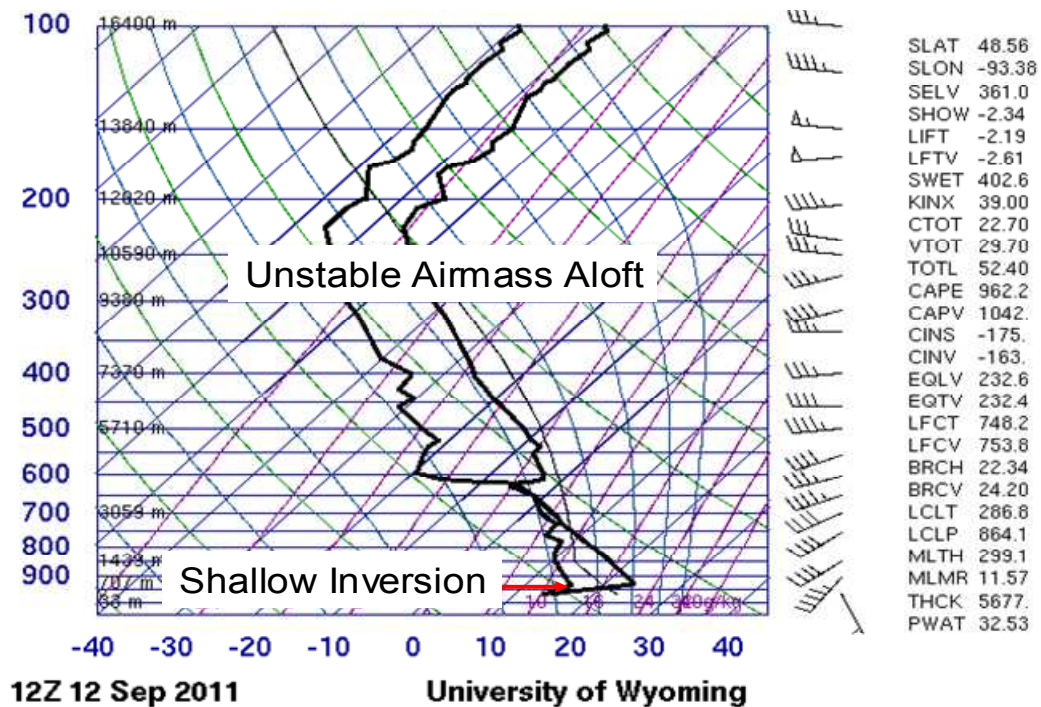


Figure 31. Atmospheric temperature gradient and wind profile for International Falls, MN (closest radiosonde release to the fire) on September 12, 2011.

The graph above displays increasing temperature above the ground for the first few hundred feet, then abruptly shifts to a rapid decrease in temperature with altitude above the ground. The steepness of the decreasing temperature gradient aided convective column development with very strong indrafts. The effect on fire behavior was a very abrupt and strong increase in rate of spread and intensity when the shallow inversion broke (at about 0900).

SUMMARY POINTS

From August 18 until September 10, 2011, the Pagami Creek Fire burned under conditions familiar to northern Minnesota firefighters and managers. Weather, fire danger indices, and fire behavior had been within parameters experienced during landscape scale prescribed fires and previous wildfires managed for resource benefit.

The decision to monitor the fire made initially on August 18 and then analyzed and affirmed in the WFDSS on August 20, 2011 was based on multiple analyses and objective data. Those decision support inputs indicated that the fire would not exhibit large fire growth within the foreseeable future. It was also recognized at that time that the Fernberg Corridor was a value that required protection.

After the August 26th 1 11/2 mile run to the SE, Superior NF managers made the decision to assign an IMT2 to so that risk associated with the Fernberg Corridor could be mitigated. Additional decisions to conduct firing operations were made to implement risk mitigation. Short and long-term weather forecasts, numerous modeling exercises and references to historical fire behavior and spread were consulted in making those decisions.

On September 9 and 10 it became clear that the fire was moving to the south and east to a greater extent than was initially predicted. Operations were planned and implemented to move visitors and all personnel assigned to the fire out of the way of expected fire spread. Any area the fire was expected to burn into within the next two days was to have all visitors and fire personnel moved out before noon of the next day.

On September 11, many visitors were moved out of the Lake One-Two-Three-Four-Hudson chain, Bridge Lake, Rifle Lake and areas in the SE including Isabella River and toward Isabella Lake. On the evening of September 11, it was determined (based on expected fire spread for the next two days) that all visitors and fire personnel should be north of "the Rock" on Lake Insula. Due to extensive fire spread the Forest decided to order an IMT1 to handle the larger and more complex nature of the fire.

However, on the morning of September 12, 2011, the seven-mile NE flank turned into a head fire when winds shifted to SW between 1000 and 1100. Windspeeds increased during the day peaking at 21 mph and shifted in direction during the burning period with the frontal passage. The atmosphere had become extremely unstable and had wind shearing for several thousand feet above the surface enabling rapid convection column development. Finally, fuel had dried to record levels and the forest to the NE was very old with accumulations of dead and down, standing snags, and ingrowth of very flammable balsam fir. The wide and deep head fire area can be seen on the satellite imagery. The tremendous

Pagami Creek Decision Support Narrative

energy released from the rapid combustion of the large expanse of these fuels contributed to a positive feedback loop in pushing the fire fast and far through intense surface and crown fire activity as well as long range spotting. The combination of these factors during a burning period is a rare event and is difficult to predict.

Report prepared by:

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Professional experience: assignments with multiple federal land management agencies, including the Bureau of Land Management, National Park Service, and US Forest Service. Permanent positions include: Fuels Specialist, Hotshot Superintendent, Fire Management Officer, Deputy Regional Fire Management Officer, National Fire Ecologist, Fire Use Program Manager and District Ranger. Assignments include experience at all administrative levels (field, state, regional, and national offices) and service in management operations and research and development.

Professional areas of focus: agency administrator, fire ecology; fire behavior; training; policy development and interpretation; program management; long-term risk assessment; decision support; use of wildfire and prescribed fire planning, operations, and management; technology transfer; and emergency response.

Training experience: actively involved in training and served as instructor, unit leader, steering committee member, and steering committee chair of local, regional, and national training courses; has conducted training in the United States, Russia, Ethiopia, and Vietnam.

Incident management experience: over 30 years of involvement in incident management team operations including service as a Type I Incident Commander on wildfires, prescribed natural fire, wildland fire use, and all hazard emergency responses.

Education: Associate of Science from the Shasta Junior College; Bachelor of Arts in History from Boise State University; and Master of Science in Forest and Range Fire Ecology from Oregon State University.

Technical information was gathered and post fire analysis was conducted by a team of national experts. These experts included:

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Jim Menakis

National Fire Ecologist, Washington Office Fire & Aviation Management
(Detached)

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Professional experience: assignments with the US Forest Service at Rocky Mountain Research Station Fire Science Laboratory and Washington Office Fire & Aviation Management. Permanent positions include: Field Ecologists, Geographic Information Specialist, Forester, Tech Transfer Specialist, Landscape Fire Ecologist, and National Fire Ecologist. Assignments include working with federal, state, and private land management agencies at all administrative levels (field, state, regional, station, and national offices).

Professional areas of focus: fire ecology; fire behavior; geographic information systems; remote sensing; training; fire research; program management; long-term risk assessment; budget allocation; decision support; fuel treatment effectiveness; and fuels monitoring.

Training experience: actively involved in training and served as instructor and steering committee member of local, regional, and national training courses.

Incident management experience: experience working with regional management teams and geographic coordination centers by incorporating the latest science into risk assessments and decision support of multiple wildfires in one geographic area; conducted fuel treatment effectiveness reviews after wildfire.

Education: Bachelor of Science from University of Montana in Natural Resource Management; and Master of Science in Environmental Studies from University of Montana.

Morgan Pence

Fire Application Specialist, Wildland Fire Management Research Development and Application

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Professional experience: employed with the Forest Service for twelve years. Positions include: firefighter on handcrews, engine, and helitack, student trainee as fire ecologist, member of the National Interagency Fuels Technology Transfer team, Fire Application Specialist with the Wildland Fire Management Research Development and Application group.

Pagami Creek Decision Support Narrative

Professional areas of focus: short and long term fire behavior, spatial fire analysis, decision analysis support, technology transfer.

Training experience: Involved in decision analysis support and fire behavior trainings, instructor/coach at Geospatial Fire Analysis Interpretation and Application national course.

Education: Bachelor's of Science in Natural Resource Ecology from University of Idaho; Masters of Natural Resources with a Graduate Certification in Fire Ecology and Management from the University of Idaho.

Ellen Bogardus-Szymaniak

Fire and Fuels Analyst, TEAMS Enterprise Unit, USDA Forest Service
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Professional experience: permanent positions include: Fire and Fuels Analyst, Fuels Program Manager, Fuels Specialist, Forest Fire Planner, Forest Training Officer, Dispatch Center Coordinator, Forest Dispatcher, and Station Supervisor. Experiences at Field, Regional, and National levels.

Professional areas of focus: fire planning, fire ecology; fire behavior; training; program management; long-term risk assessment; decision support; use of wildfire and prescribed fire planning, operations, and management; and emergency response.

Training experience: actively involved in training and served as instructor and unit leader of local, regional, and national training courses.

Incident management experience: over 21 years of involvement in incident management team operations including service in a variety of positions on wildfires, prescribed natural fire, wildland fire use, and all hazard emergency responses.

Education: Bachelor of Science in Environmental Education and Bachelor of Arts in Jazz Education from Ohio State University; over 25 hours of graduate level course hours in fire ecology and disturbance ecology.